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Presented to:
SA Resources Industry Development Board

Status of Geothermal Energy in SA

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Presentation Outline

- Corporate Overview
- Key Messages
- Global context for renewables/geothermal
- Overview of Australian Geothermal Energy industry
- SA geothermal energy sector
- Challenges for geothermal energy projects
- Potential solutions
- Progress reports on selected projects
- Conclusion

Corporate Overview



Key Statistics

- Current shares on issue – 57.9m (plus 13.77 m options)
- Market capitalization - \$21.5m (at share price of \$0.37)
- Cash - \$3.3m
- Major shareholder - Minotaur Exploration (34%)

Projects

- 11 projects spanning **South Australia, Spain and China** – EGS, conventional and direct heat
- **Flagship project** – Paralana
- **Exciting growth projects:**
 - Direct heat, conventional and EGS geothermal projects covering Madrid, Barcelona and the Gran Canaries
 - Exclusive government supported exploration agreement in China

Joint Venture Partners

- Beach Petroleum (up to 36% for \$30m)
- TRU Energy (up to 30% for \$57m)

Key Messages

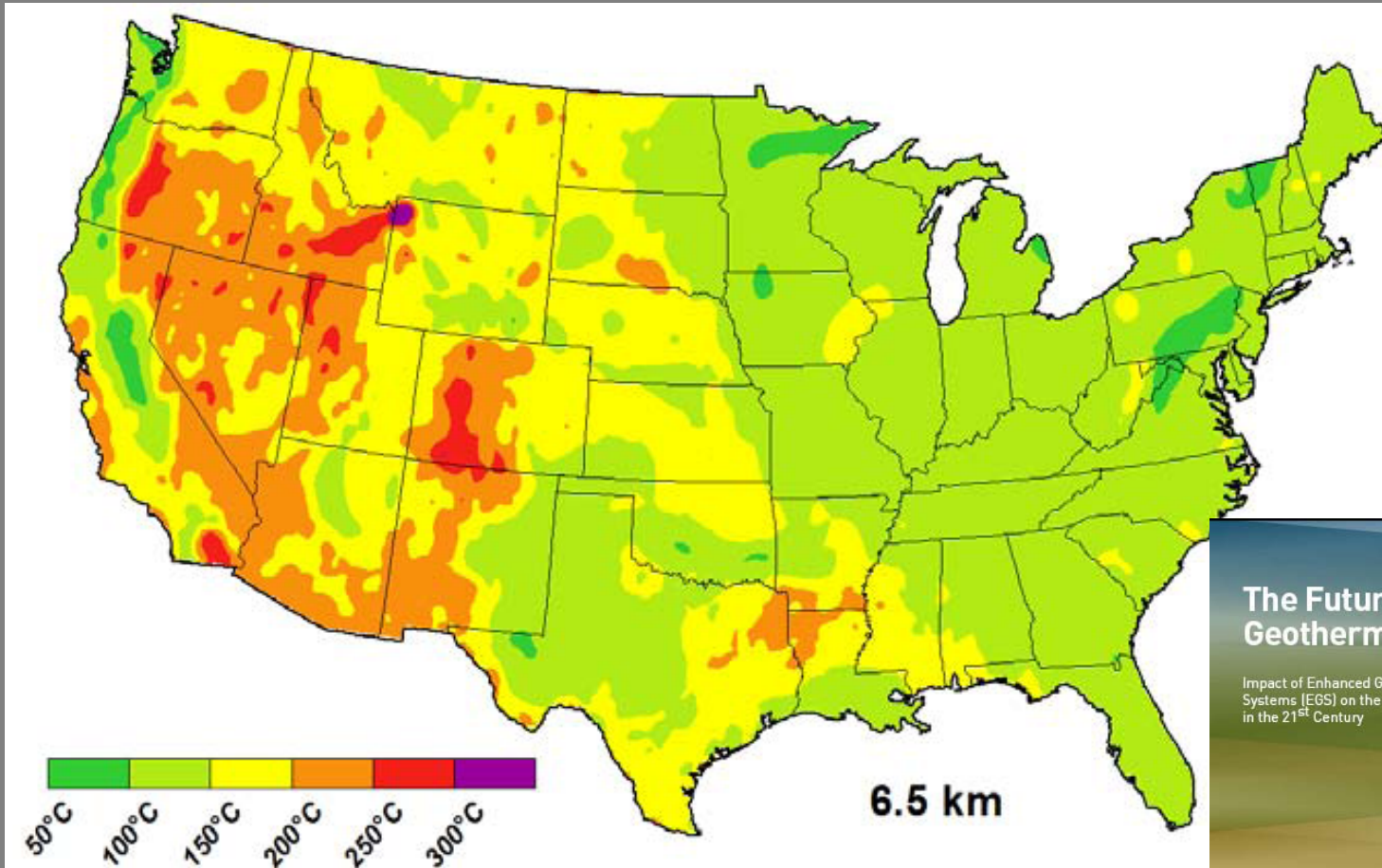
- Geothermal energy has the potential to provide large scale, base load and low cost renewable energy.
- Australia has the key ingredients for developing successful EGS projects – high heat producing granites, continent under compression, strong commitment from government and financial markets.
- SA has the best known EGS (hot rock) geothermal resources in Australia with approximately 90% of Australia's activity focused in South Australia.
- EGS projects face a number of challenges, including but not limited to – drilling, achieving adequate flow rates, power conversion efficiency, cost of delivery to market (proximity) and water issues.
- Further government support is needed with increased capital funding coupled with increased industry cooperation (R&D, drilling and network connection).

Global Context for Energy & Renewables

(extract PTR Business Plan - December 2007)

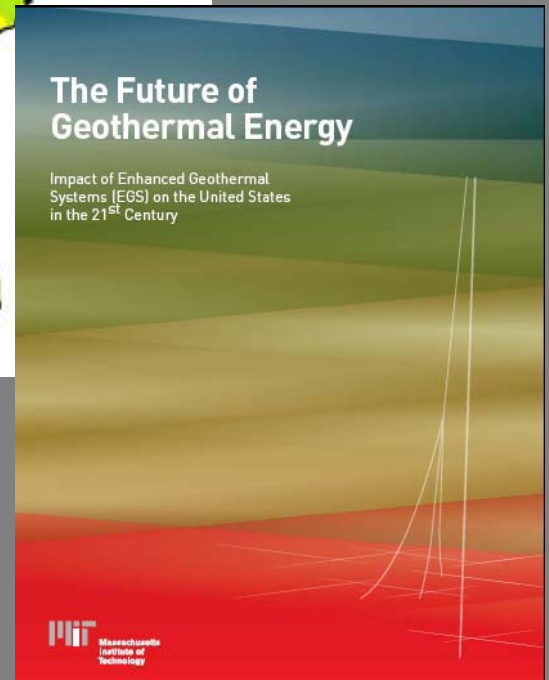
- **Operating in an uncertain global economy and with more volatile financial markets** - European economies expected to slow, Asian economies to continue to grow strongly, Australian economy to remain strong but weakness (recession?) in the US economy.
- **Increasing cost of energy/power globally**, combination of increased electricity demand, increasing cost of fuel and water, pressure on manufacturers and providers of raw materials (developing and developed countries).
- **Global political and social pressure** to implement major greenhouse gas reduction and renewable energy programs, Europe underway, Australia about to expand, parts of Asia moving and more expected from the US.
- **The above issues will combine to drive toward the need for low cost, large scale (preferably base load) renewable/low emission technology** - geothermal, solar, wind and in some countries nuclear and gas.

Drivers - The Promise of Geothermal

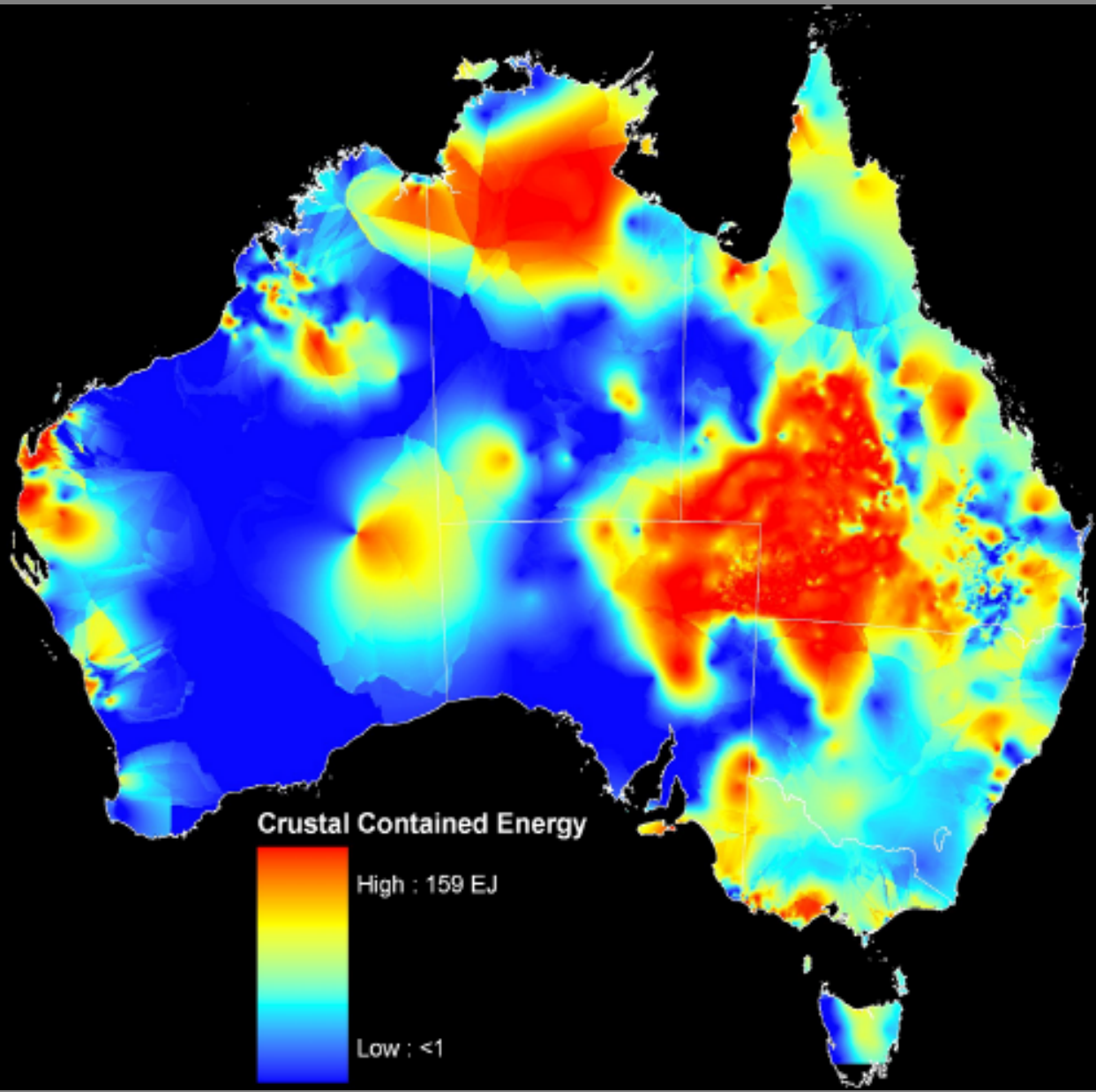


MIT (Tester, et al 2006)

- 100 GWe hot rock power in the USA by 2050
- ~13.7 billion PJ resource to 10 km.
- 130,000 X annual primary energy use in the USA



Drivers - The Promise of Geothermal



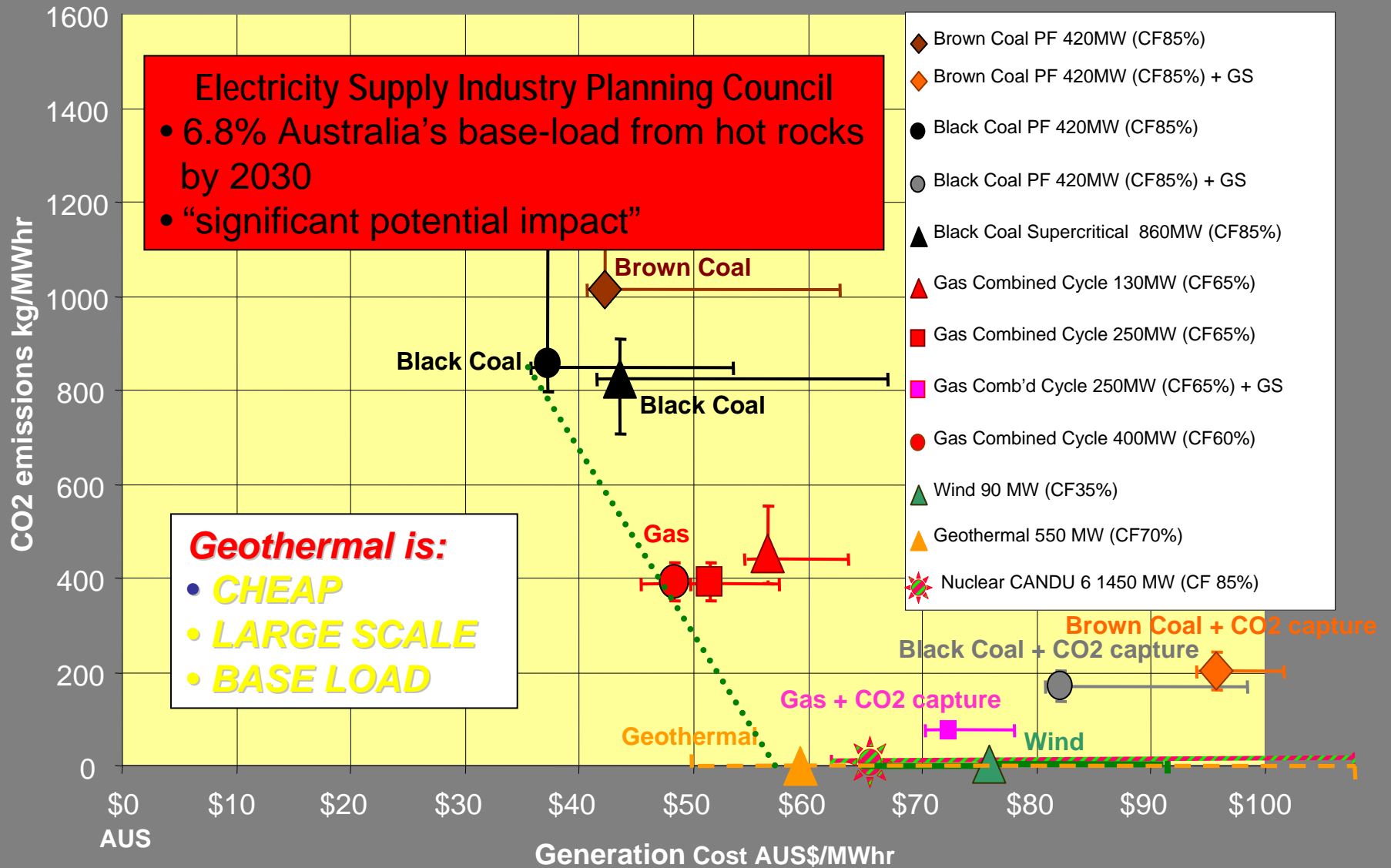
Indicative Resource Map

**Australia's hot
rock energy 150°C
to 5km ~ 1.2
billion PJ**

**~20,000 X annual
primary energy
use in Australia**

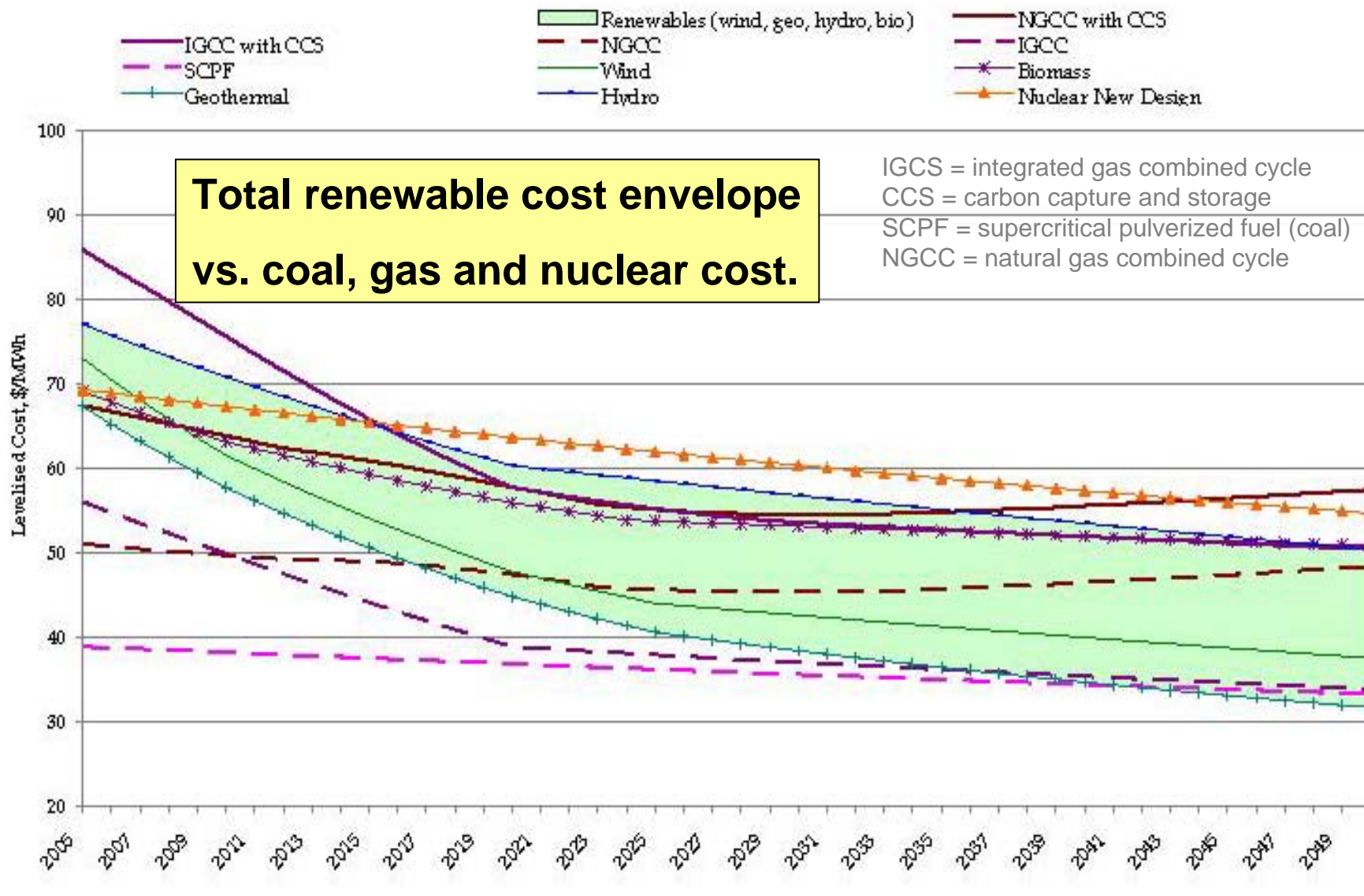
Source: Geoscience Australia (2007)

Geothermal Energy Cost Comparison



COMBUSTION CO2 EMISSIONS vs LONG RUN COST
 (Source: PIRSA Compilation of ESIPC data 2006-07)

Long Run Costs of Energy Technologies



MMA Report on Geothermal - Findings

- Geothermal energy expected to build up to 2,200 MWs of base-load capacity by 2020;
- An estimated \$12 billion would be invested to develop that capacity;
- Represents up to 40% of the Federal Government's 2020 Renewable Energy target of 45,000 GWh - the equivalent of the output of around 6,000 MW of wind farms;
- Generation costs are expected to move rapidly down the cost curve from around \$120 /MWh at small scale (10 MW to 50 MW) and decreasing to around \$80/MWh at large scale (300 MW or greater) by 2020; and
- Most of the capacity is expected to come from developments in SA - other states increasing their contribution toward by 2020

Renewable Energy Policy & Geothermal

- Federal Labor Government Clean Energy Plan to ratify Kyoto, Emissions Trading Scheme, 20% Renewable Energy target by 2020, \$485 M Renewable Energy Fund (\$50 M drilling initiative fund - 7 projects, demonstration project funding) & \$150 M Energy Innovation Fund
- The **Australian Geothermal Energy Group (AGEG)**, developers/companies, academic/research institutions and government departments federal/state – **collaborative work**
- The **Australian Geothermal Energy Association (AGEA)** – developers/companies and service companies – **Policy and Advocacy notably to governments.**
- The **Australian Geothermal Energy Industry Development Framework** – Federal initiative **aims to grow the Industry**

Australian Geothermal Energy Association



The national industry association for the Australian Geothermal Energy Industry

AGEA's Vision. Geothermal energy providing the lowest cost emissions-free renewable base load energy to Australian homes and businesses for centuries to come.

AGEA's Mission. foster and accelerate the development and commercialisation of Australia's geothermal energy resources by:

- Clearly and accurately articulating the advantages of geothermal energy and the progress of the industry;
- Cooperating across the industry to develop, collect, improve and disseminate information about geothermal energy; and
- Developing good and constructive relationships with government, the investment community and the broader Australian community.

AGEA's Work. Increasingly provide both:

- a low cost, emissions free, baseload, reliable and secure supply of energy into the national market over the next decade; and
- a reliable, low cost source of heat to drive energy efficiency and industrial applications.

AGEA works with all Australian Governments, the academic community, relevant scientific organisations and the media to promote information about the progress of the industry and its capabilities.

AGEA seeks to assist government develop prudent policy mechanisms that enable all forms of emissions free energy to increasingly penetrate the national energy market in line with climate change and energy security policy goals that are in the national interest.

AGEA's membership comprises the major geothermal energy project developers, direct heat equipment suppliers and service providers to the industry.

Australian Geothermal Energy Group (AGEG)

AGEG'S VISION: *Geothermal resources to provide the lowest cost emissions-free renewable base load and direct use energy for centuries to come.*

- Currently 88 members and growing
- Includes all companies with geothermal licences, all Federal, State and NT government agencies with a role in upstream energy policy and investment attraction and 10 Australian universities

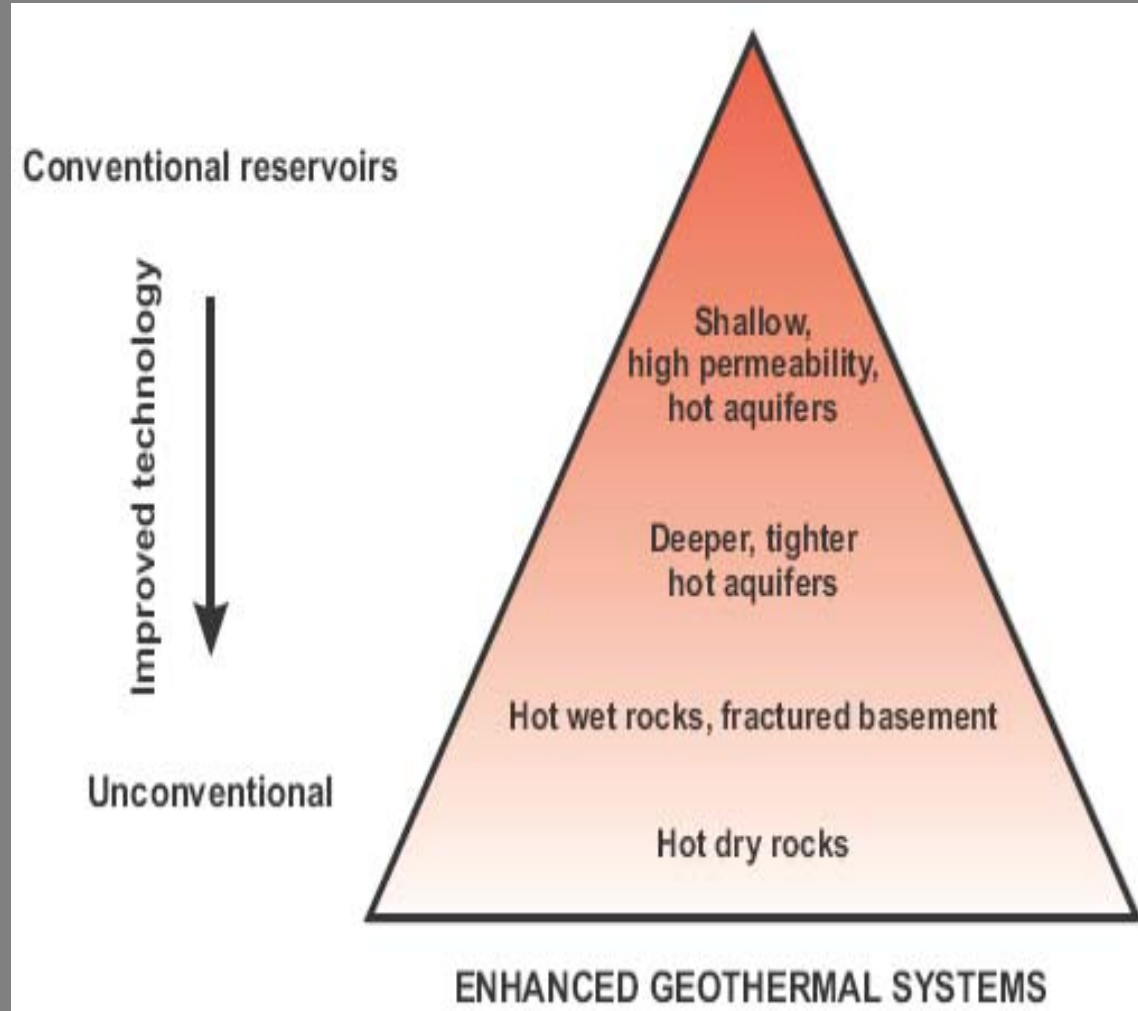


<http://www.pir.sa.gov.au/geothermal/ageg>

Geothermal Industry - Challenges

Cost Drivers

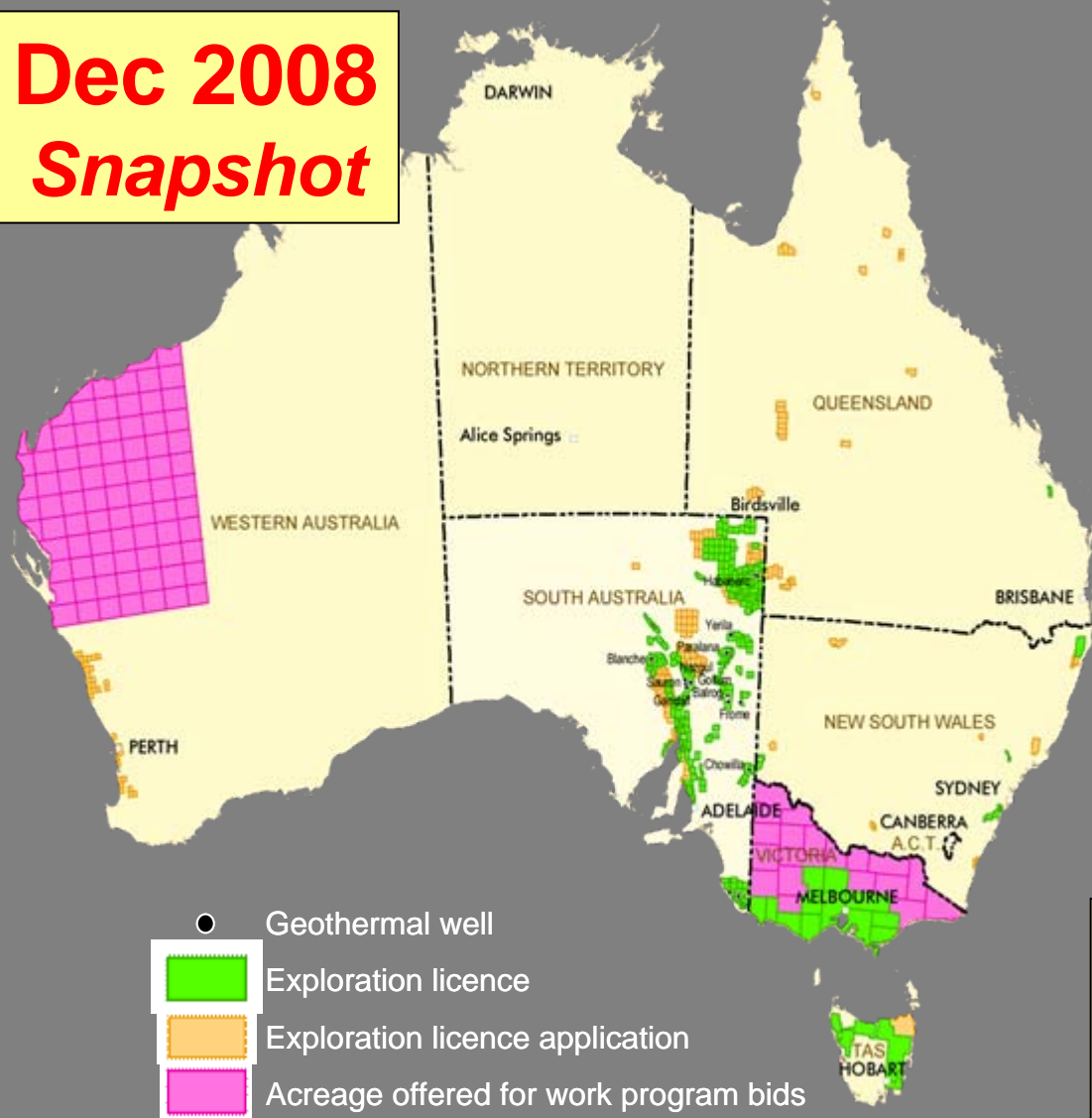
- Temperature
- Drilling Depth
- Flow Rate
- Network Connection
- Generation Plant



High up front costs – drilling, fraccing, connection, plant
(low O/M + no fuel costs)

Growth of Australian EGS Industry

Dec 2008
Snapshot



GELS / GELAS

Aust. 367

S.A. 273

Expenditure

Aust. > \$1000 Mill

S.A. ~ \$ 700 Mill

- **48 Companies**
- **10 ASX listed**

Geodynamics/Origin/Tata Power/Sentient-SunPower

- 2003-5: Proved flow of geothermal energy with Habanero 1 & 2
- 2007-8: Habanero 1 - 3 closed loop flow tests, Jolokia 1 drilled.
- Next: 1 MW demo, Savina 1 and HOTROCK50 project

Geothermal Drilling

Petratherm/Beach Petroleum/TRUenergy

- 2005-7: Drilled Yerila and Paralana, deepened Paralana & recorded MT + seismic
- Next: Petratherm JV to drill deep Paralana well starting in 2Q/09

Green Rock Energy

- Drilled and Mini-Frac'd – Blanche 1 to 1935m
- Next: Optimise plans for a deep well.

Geothermal Resources

- 2007-8: drilled 6 Frome area wells up to 500m depth
- Currently drilling deeper test well

Torrens Energy/AGL

- 2007-8: drilled 5 of 9 wells in Lake Torrens region
- Next: Shallow drilling near Torrens Island

Inferus Resources (Southern Gold Ltd)

- 2008: Measured temperatures in minerals hole to 1 Km
- Next: Seismic and shallow drilling

Eden Energy

- 2007-8: Chowilla 1 in Renmark region
- Next – Assessing options for a deeper test well

Panax

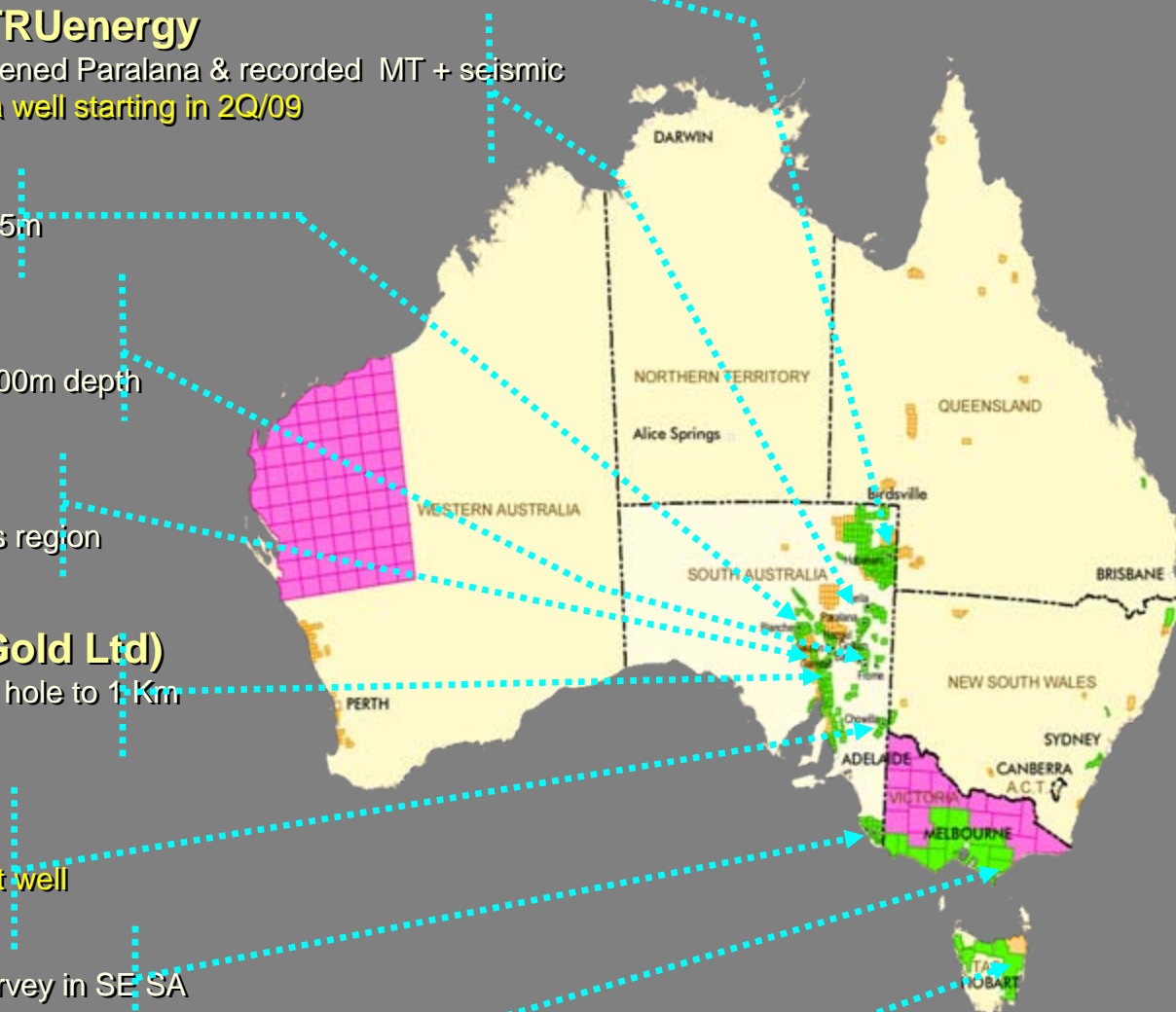
- 2006 – 3 wells to 500m depth & an MT survey in SE SA
- Bid for Osiris - and raising \$20 million
- Next – Drill a deep test well in 2009

Greenearth

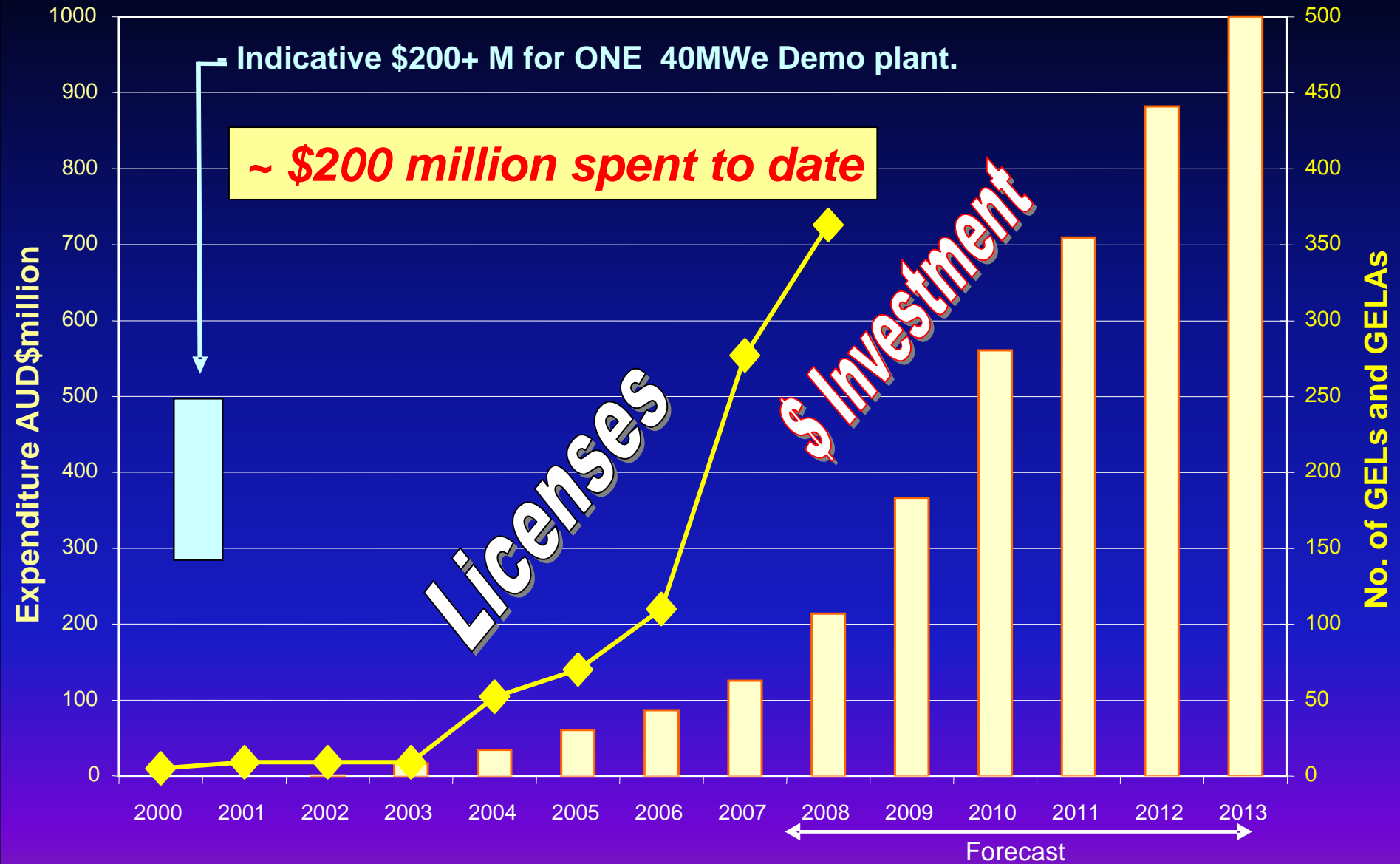
- Gained thermal data from 4 gas wells drilled in '07
- Next – MT surveys to locate deep wells

KUTh Energy Ltd

- 31 shallow drillholes (~20x20 km grid) for heat flow measures
- Next: Holes to 1,500m, then deep drilling



Growth in Australian Hot Rock Projects



Drivers - Govt. Legislation and Support

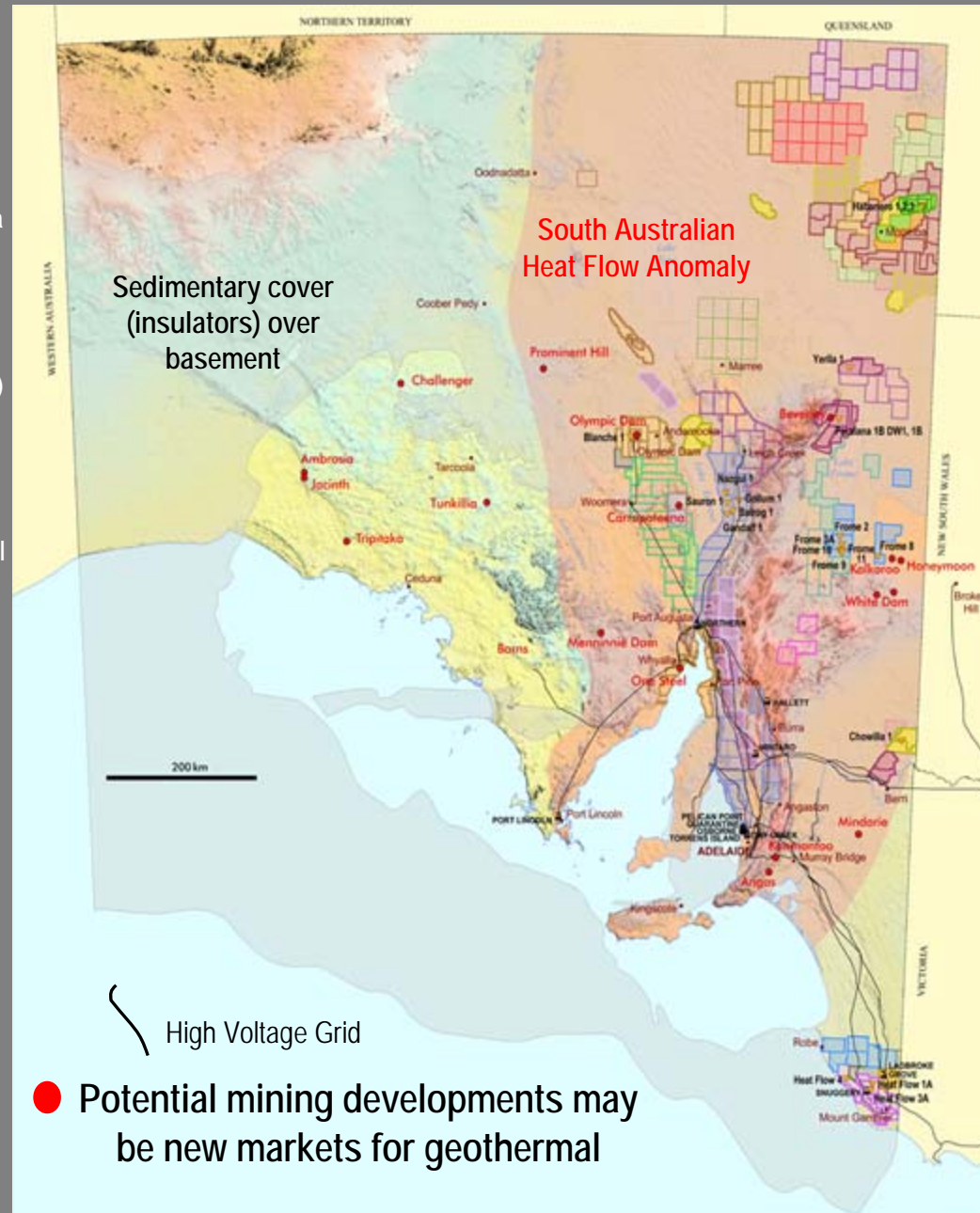
1. Geothermal Tenure - SA, Vic, Tas, NSW, QLD, WA (and NT soon)
2. RECS, NGACS, VRECS, Carbon Schemes
3. State and Federal Govt. grants ~ \$100 Million since 2000
4. Geothermal Industry Development Framework – COAG Initiative
5. Australian Geothermal Energy Group (AGEG)
Australian Geothermal Energy Association (AGEA)

Hot Rock Projects in South Australia – 31 Dec 08

- 28 companies in the hunt in 273 licences on variety of plays covering >125,683 km²

- | | |
|---------------------------------|-----------------------------|
| ✓ Geodynamics ✨ | ✓ Tri-Star Energy |
| ✓ Petratherm ✨ | ✓ Clean Energy Australasia |
| ✓ Geothermal Resources ✨ | ✓ Osiris Energy |
| ✓ Green Rock ✨ | ✓ Origin Energy ✨ |
| ✓ Torrens Energy ✨ | ✓ Callabonna |
| ✓ Eden Energy/Terratherma ✨ | ✓ Deep Energy |
| ✓ Panax ✨ | ✓ Inferus (Southern Gold ✨) |
| ✓ Pacific Hydro | ✓ A-B-L-R Joint Venture |
| ✓ Teck Cominco ✨ | ✓ AAA Energy |
| ✓ Granite Power | ✓ Earth Heat |
| ✓ Gradient Energy | ✓ New World Energy |
| ✓ AGL ✨ (w/Torrens Energy) | ✓ Near Surface Geothermal |
| ✓ TRUenergy ✨ (w/ Petratherm) | ✓ Stuart Petroleum ✨ |
| ✓ Tata Power ✨ (w/ Geodynamics) | ✓ Beach Petroleum ✨ |
| ✨ ASX Listed | ✨ International SX Listed |

- > A\$730 million in work programs (excludes demo & up-scaling for deployment)
- Generalised play ingredients: Amagmatic conductive heat source, geothermal reservoir and insulating cover – combining to enable economic flow rates of sufficient heat energy to meet markets

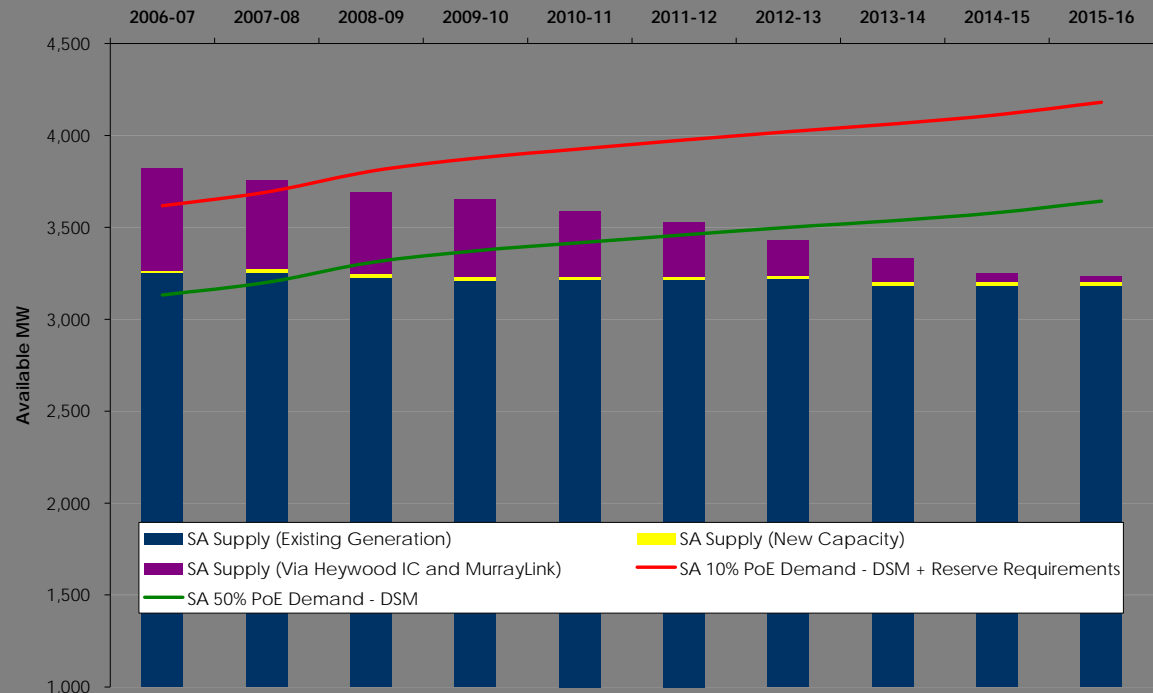


● Potential mining developments may be new markets for geothermal

SA Electricity Market

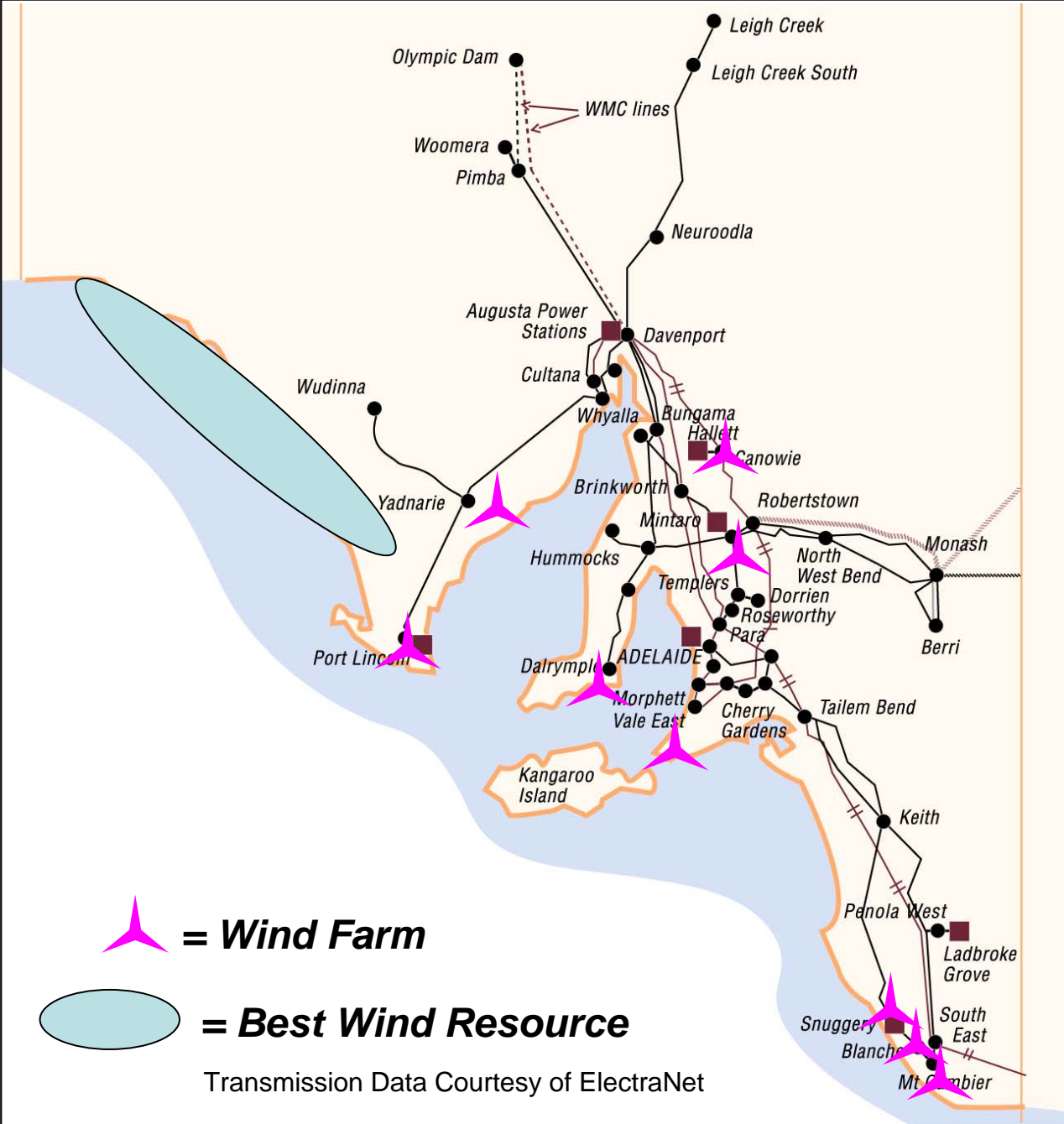
- SA NEM region electricity demand to require at least 600MW of new capacity
- Does not include potential increase of over 400MW from Olympic Dam.
- Nor the effect of depleting Leigh Creek coal.
- Demand requirements will be between 600 – 1,500MW.

Forecast Supply
Demand Balance for
South Australia (source
SA ESIPC APR 2006)



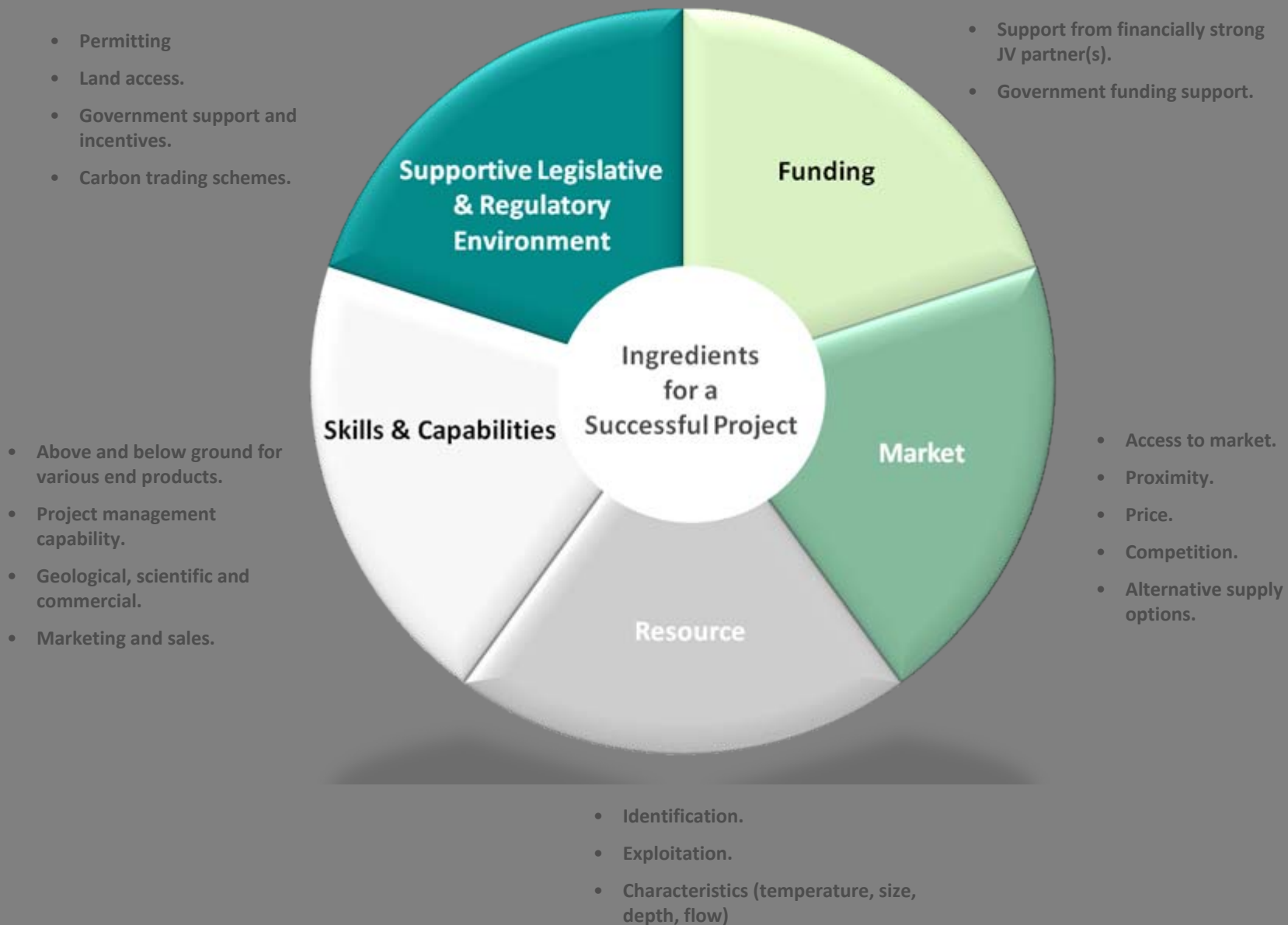
Network Access & Connection

- Transmission Costs
- Transportation losses
- Margin Loss Factor
- System Stability
- Development Approvals, Licensing, Easements and Permits
- Network Capacity at connection point



Necessary Ingredients...

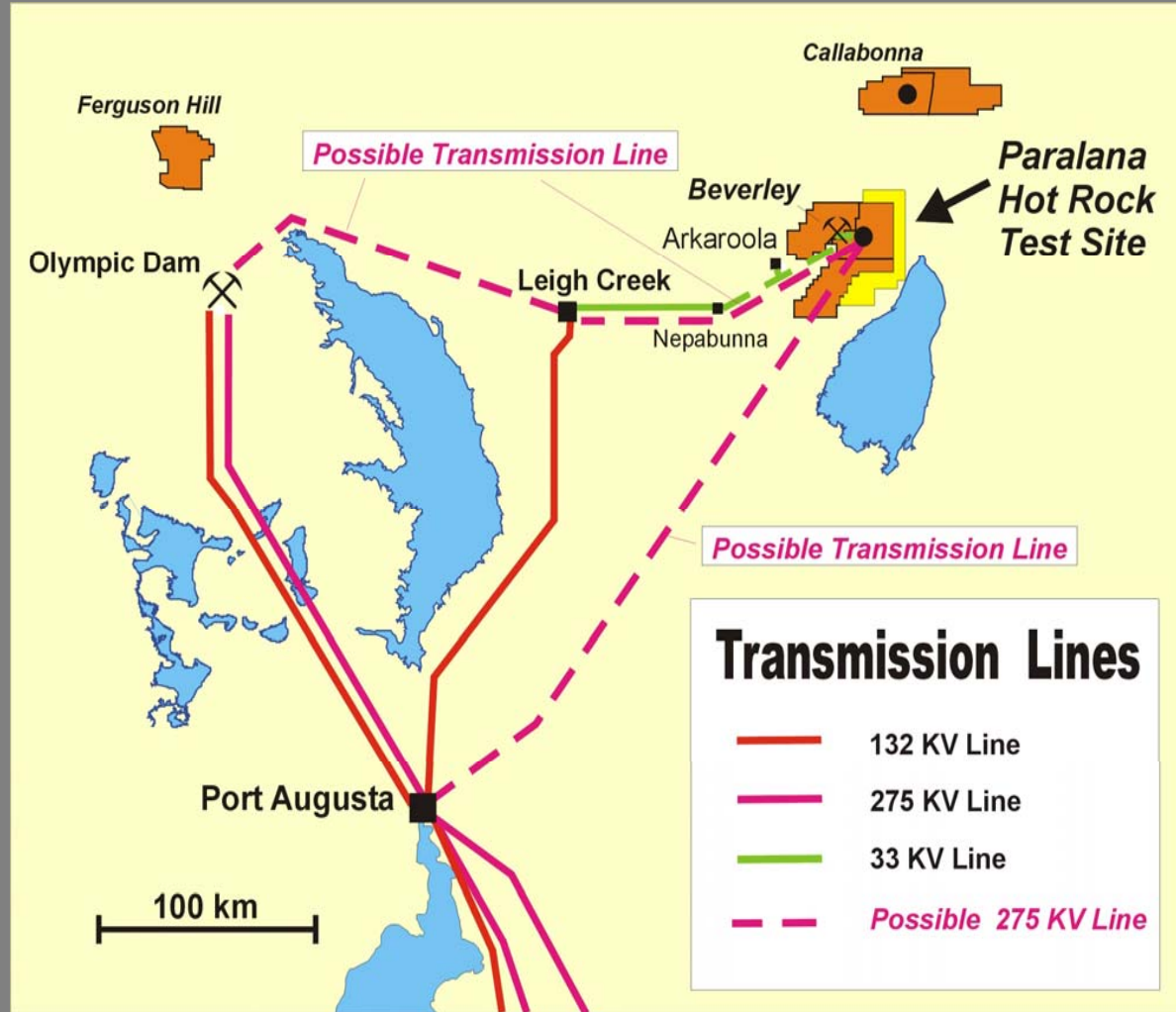
...to successfully take a geothermal project to market



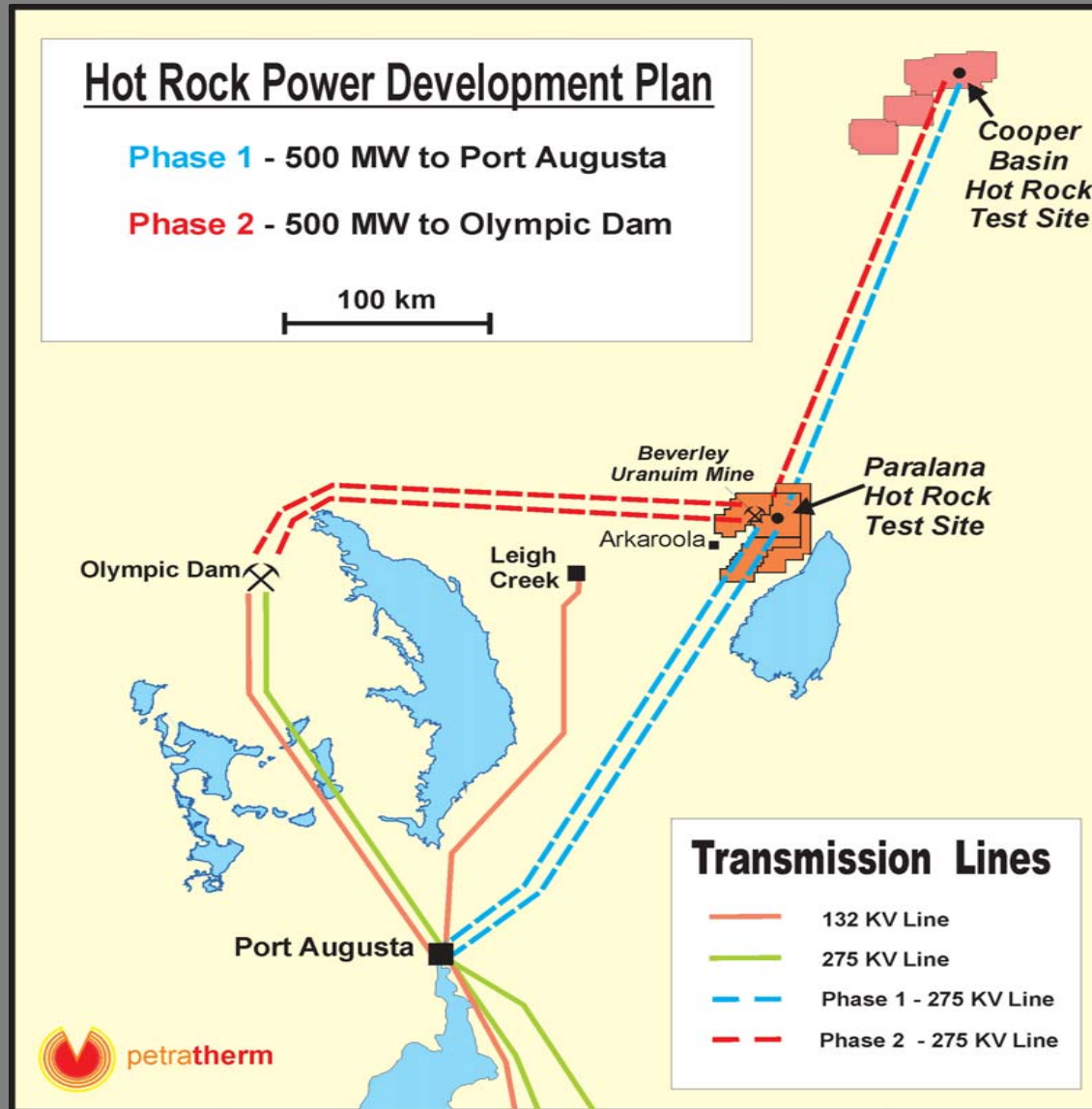
Challenges for EGS Projects

- Securing a quality site – the three locations - resource, market, permits/approvals – optimizing economics in a competitive market.
- Confirming the quality of the potential resource – temperature differential, stress regime / permeability.
- Deep drilling of wells – well design, drilling rig availability and costs.
- Establishing long-term circulation between injection and production wells -permeability, fracturing, flow rate.
- Integration of above-ground generation plant with below-ground thermal resource, achieving reliable power plant output – then followed by up scaling of generation capacity.
- Electrical connection (transmission) to the National Electricity Market.
- Water quality, usage, net losses, rights, obligations, accessibility, environmental impacts – short and long term – small and large scale.

Transmission Connection - Meshed

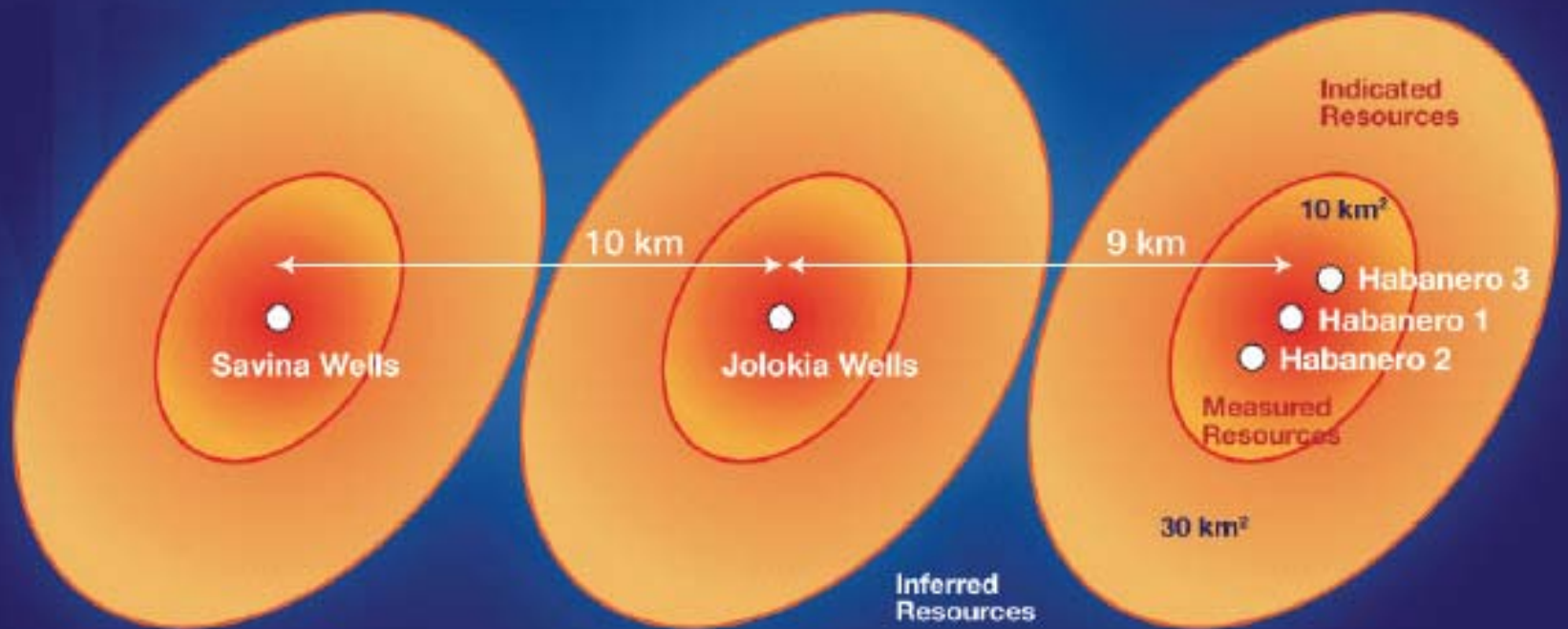


Transmission Connection – Enhanced Meshed



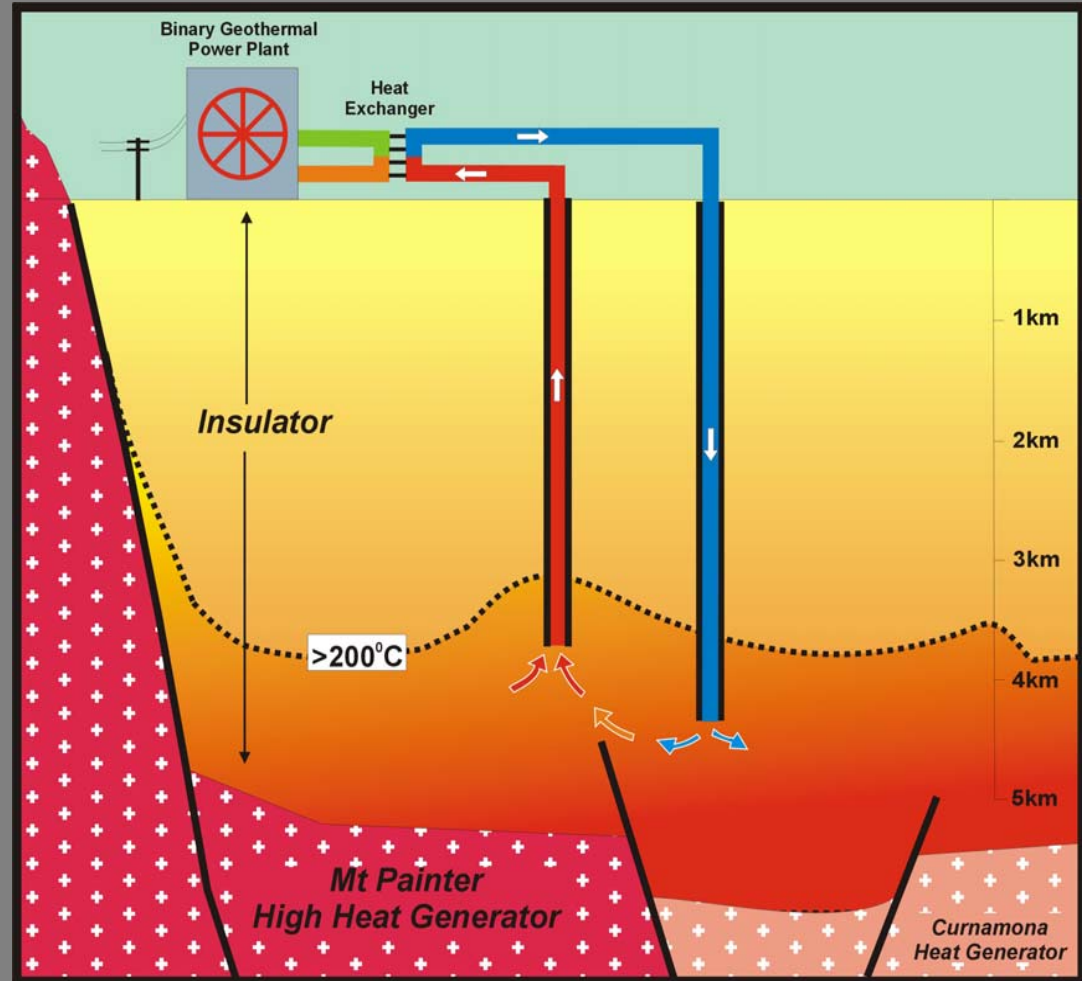
Drilling Program & Reserves Delineation

- Savina 1 – planned completion March 2009
- Target Depth currently 4,300 m (option to extend to 5,000 m)
- Multi fracture Stimulation at Jolokia 1 or Savina 1 (TBC) - March to June 2009
- Jolokia 2 or Savina 2 (Locations TBC) - July to November 2009



Paralana 2009 Development Plan

- *Second Quarter 09
First Deep Well to ~
4 Kms*
- *Well testing and
stimulation program*
- *First Quarter 2010
Second Deep Well*



Heat Exchanger Within Insulator (HEWI) Model

World's First Commercial EGS Plant Landau Germany

- Opened Oct. 2008
- 155°C, 60 l/s
- 3 MWe + heat
- Expanding to 8MWe
- ORC Cycle
- Cost \$20 M Euro



Conclusion

- Geothermal energy has the potential to provide large scale, base load and low cost renewable energy.
- Australia has the key ingredients for developing successful EGS projects – high heat producing granites, continent under compression, strong commitment from government and financial markets.
- SA has the best known EGS (hot rock) geothermal resources in Australia with approximately 90% of Australia's activity focused in South Australia.
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Thank You



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